

**FIG. 1a**

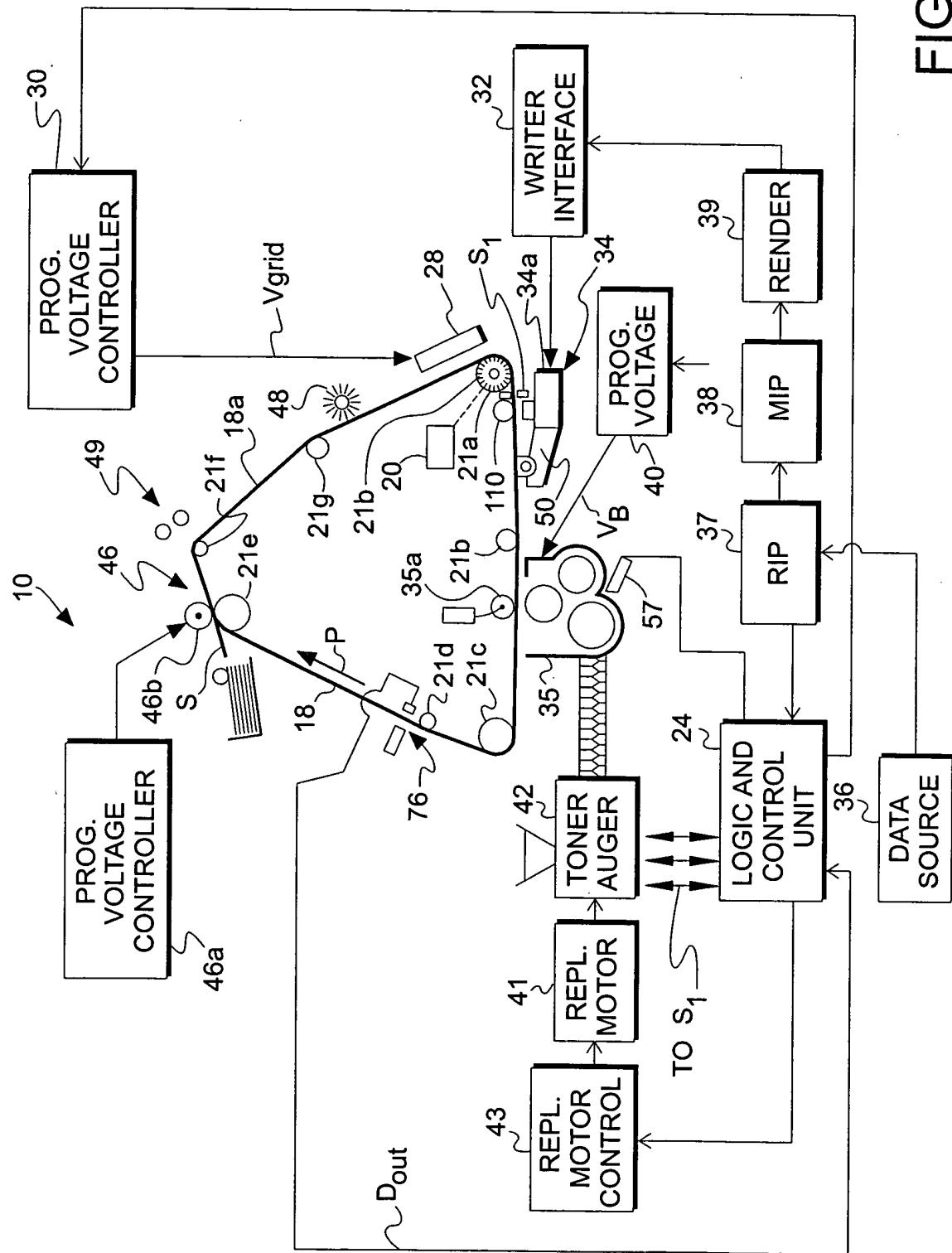
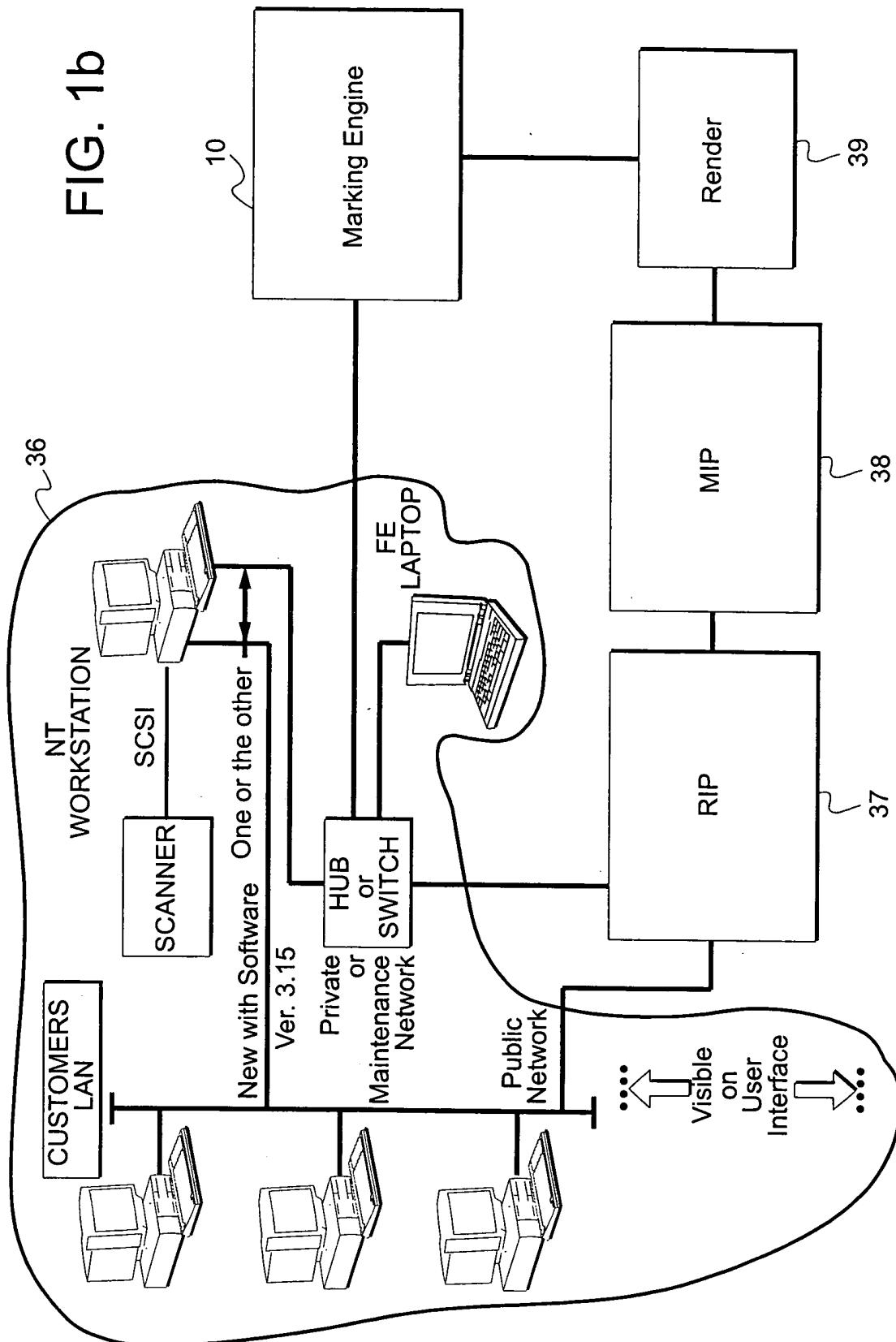


FIG. 1b



## Algorithm Block Diagram

39

Thinning/Thickening Mode

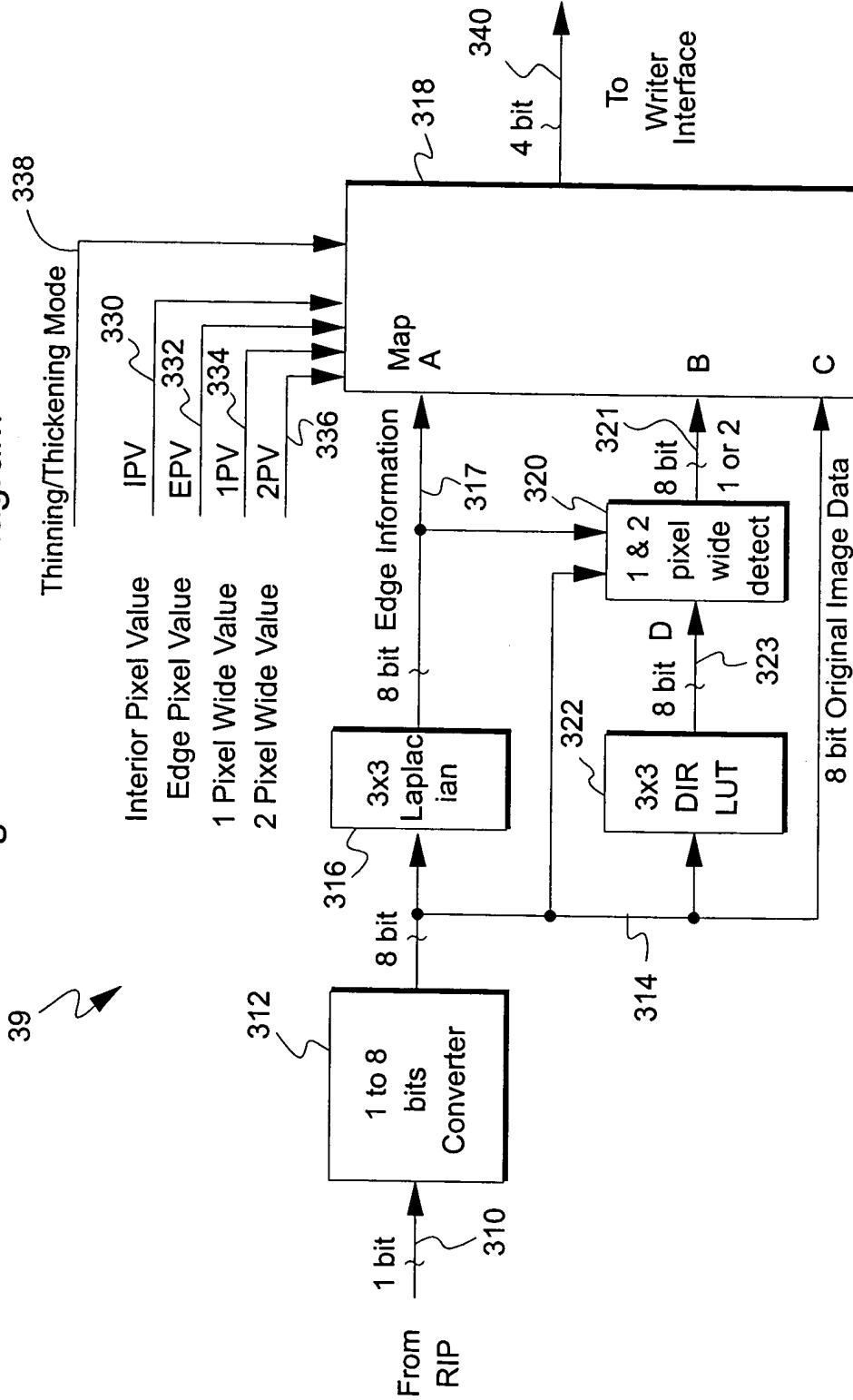


FIG. 2

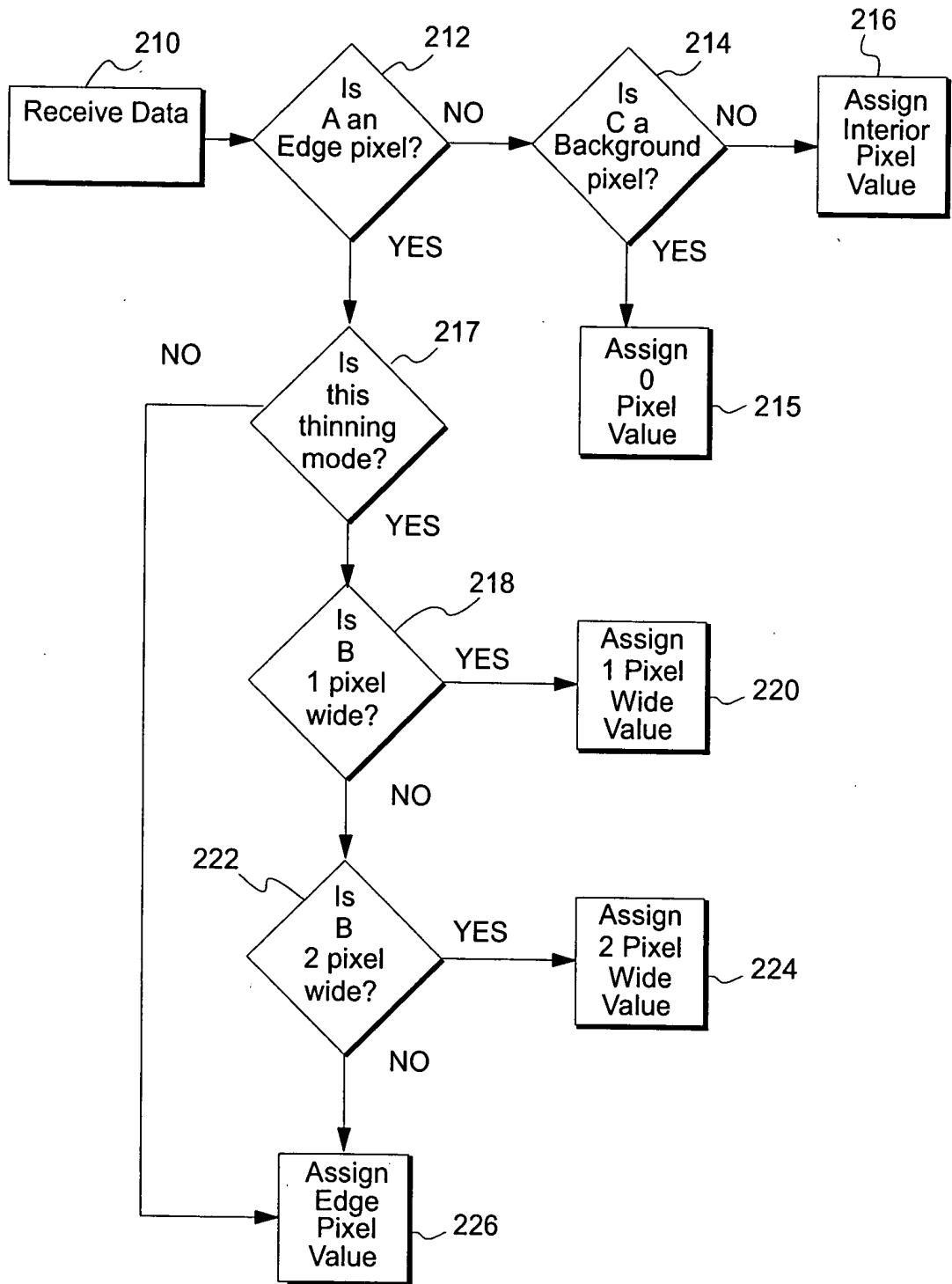


FIG. 3

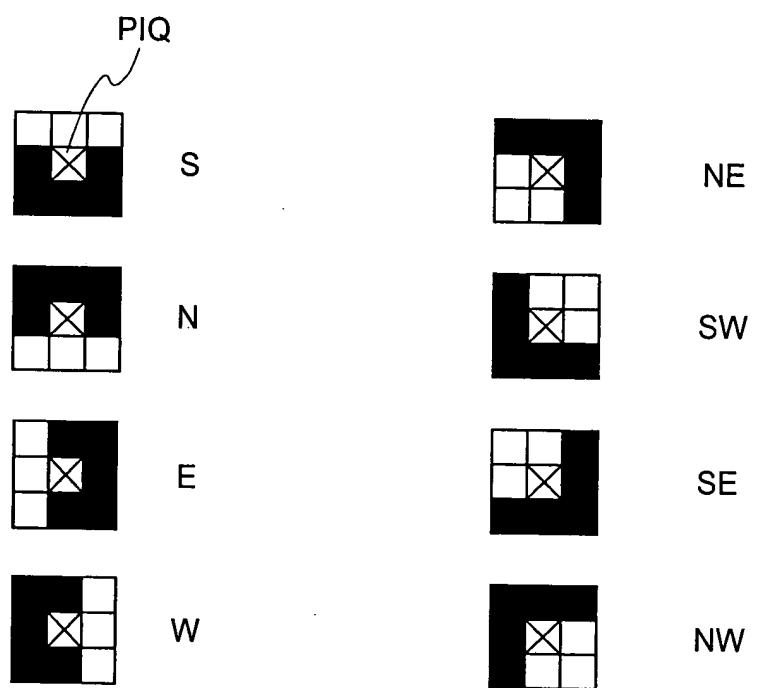
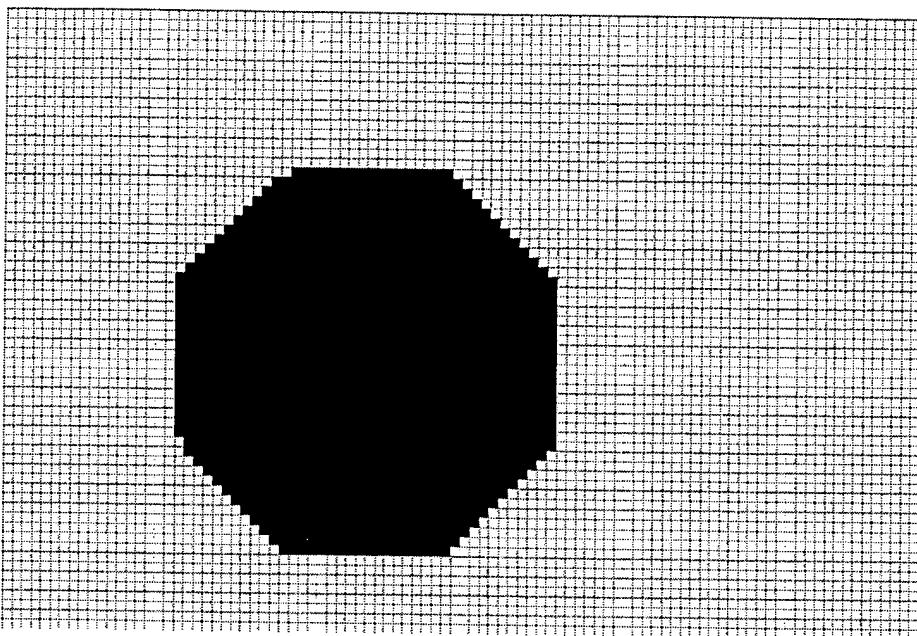
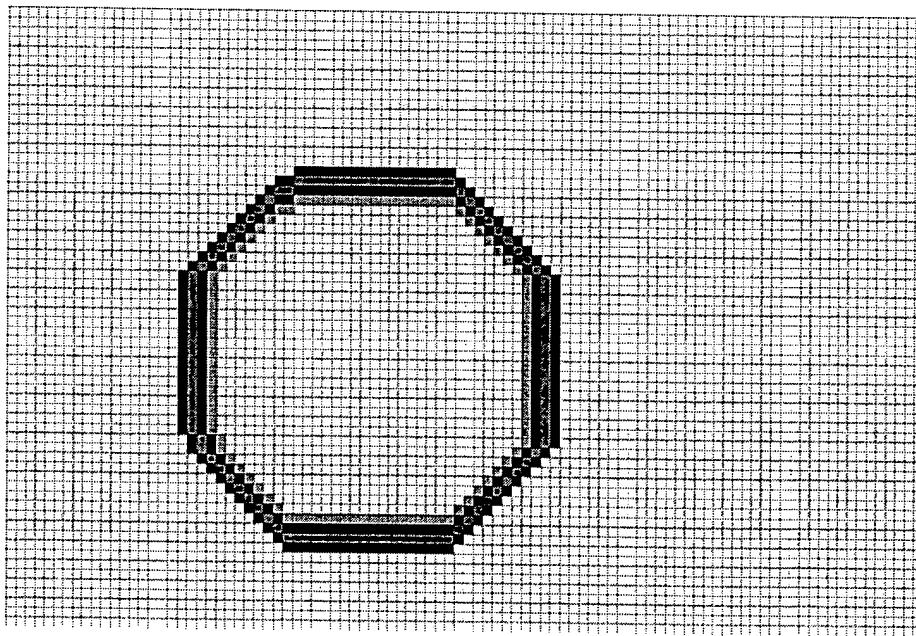


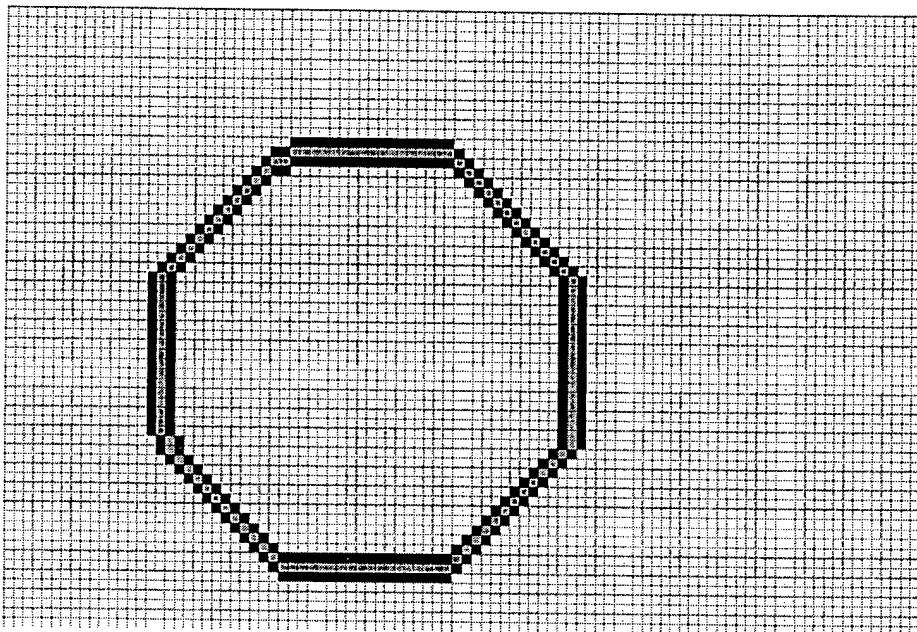
FIG. 4



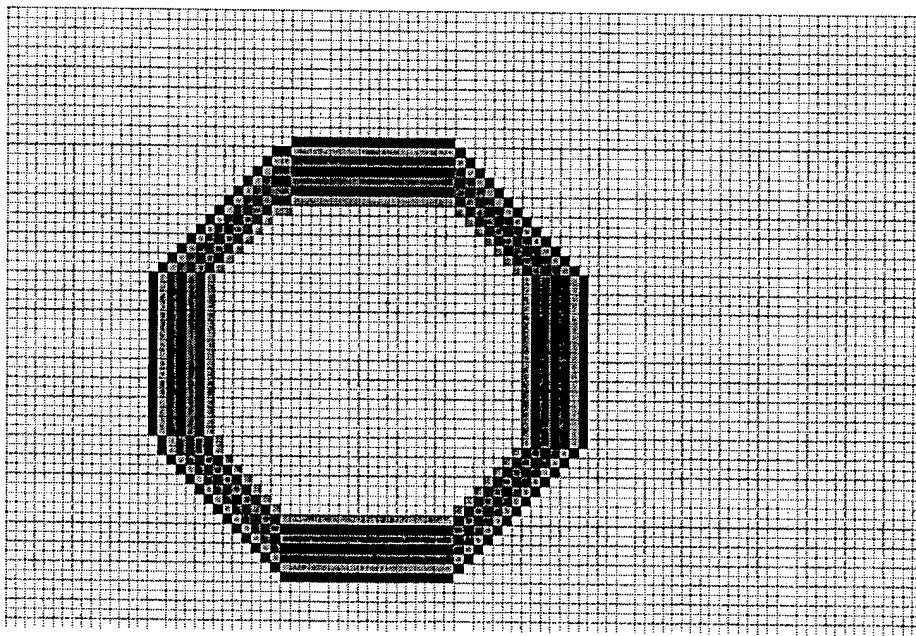
**Fig. 5a**  
Original object bitmap



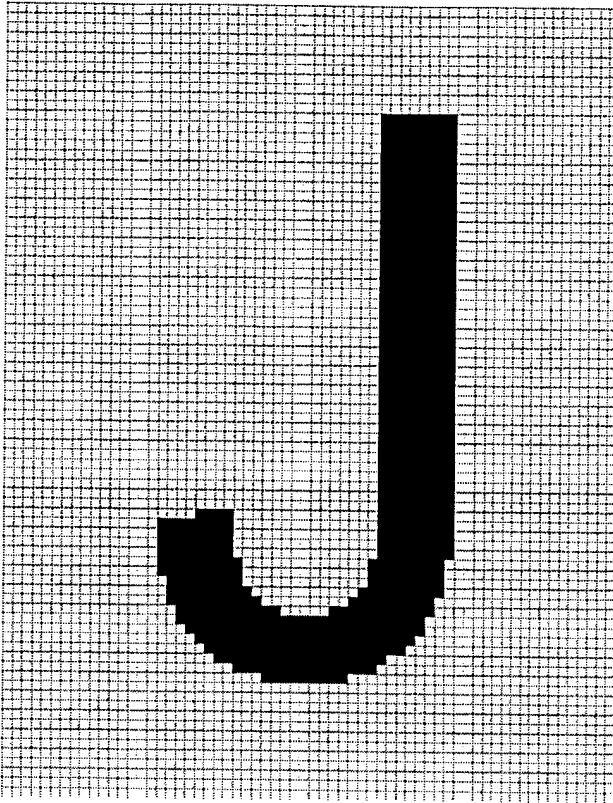
**Fig. 5b**  
Four onion skin layers  
when thinning



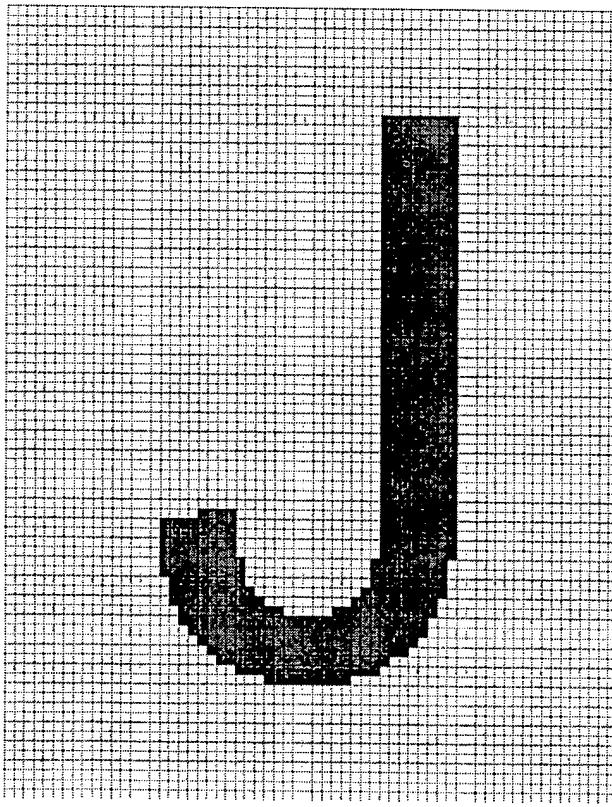
**Figure 5c**  
Three onion skin layers  
when thickening



**Fig. 5d**  
All layers  
(thickening and thinning)



**Fig. 6a**  
Original



**Fig. 6b**  
Same grey pixel value  
assigned to edges and  
solid area density

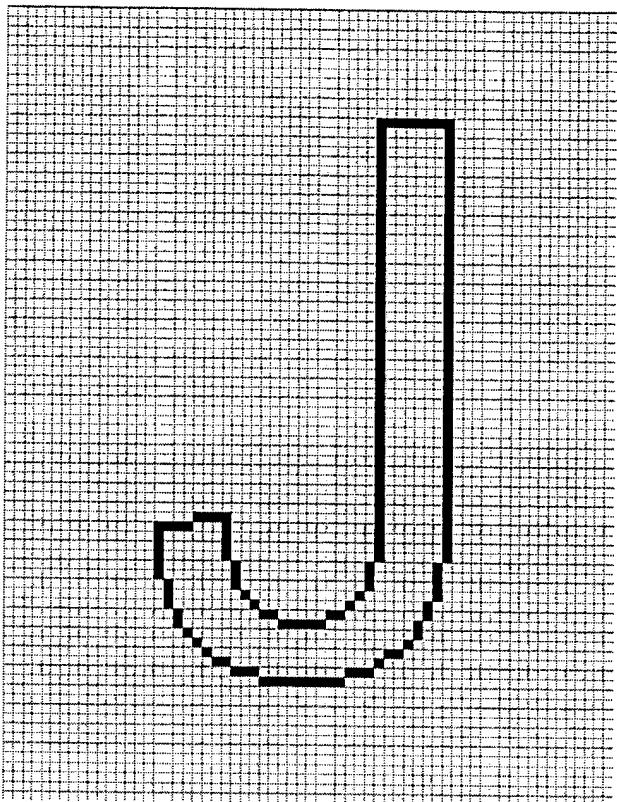


Fig. 6c  
Edges when  
thinning

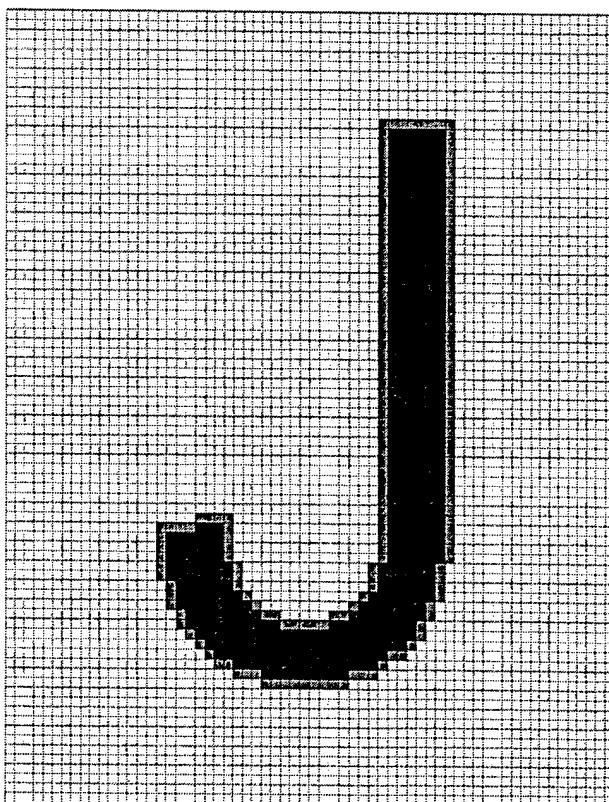


Fig. 6d  
Lightened -  
Solid area density reduced  
Letter thinner

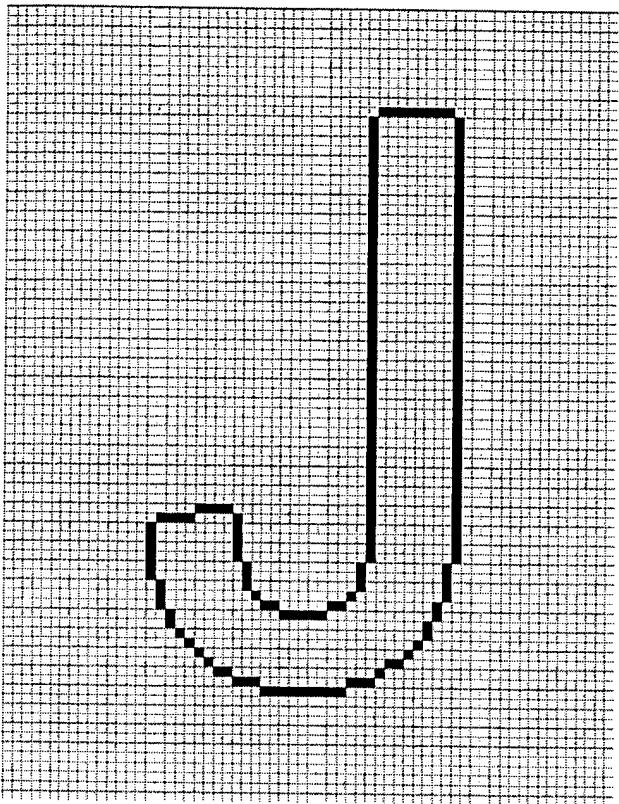


Fig. 6e  
Edges when  
thickening

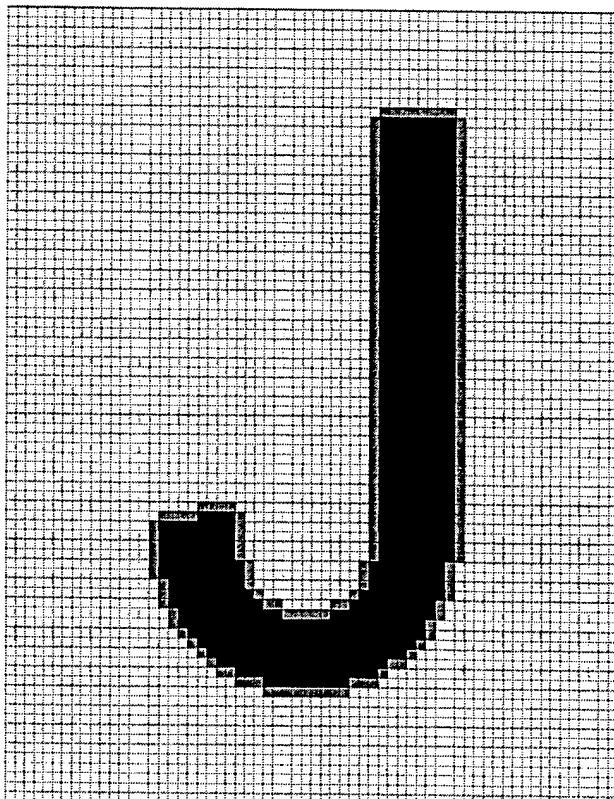
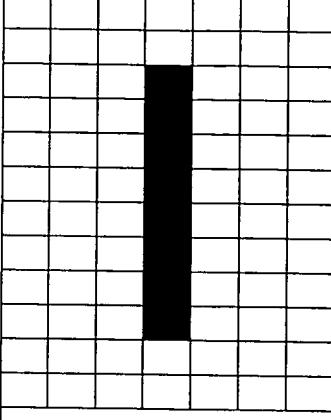


Fig. 6f  
Thickened  
Letter thickened by  
applying grey edges which  
were originally white



0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	255	0	0	0	0	0	0	0	0	0	0	0	0
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
BP	BP	BP	BP	EP	BP										
BP	BP	BP	BP	1W	BP										
BP	BP	BP	BP	1W	BP										
BP	BP	BP	BP	1W	BP										
BP	BP	BP	BP	1W	BP										
BP	BP	BP	BP	1W	BP										
BP	BP	BP	BP	1W	BP										
BP	BP	BP	BP	EP	BP										
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP
BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP

1 Pixel Wide Detection

Original 1 pixel wide line

FIG. 7a

Edge Pixels

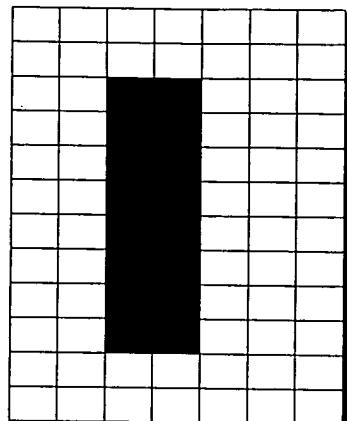
FIG. 7b

Direction Values

FIG. 7c

Assignment  
 BP: Background Pixel  
 EP: Edge Pixel  
 1W: One Pixel Wide Line

FIG. 7d



2 Pixel Wide Detection

Original 2 pixel wide line

**FIG. 8a**

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	255	255	0	0	0
0	0	255	255	0	0	0
0	0	255	255	0	0	0
0	0	255	255	0	0	0
0	0	255	255	0	0	0
0	0	255	255	0	0	0
0	0	255	255	0	0	0
0	0	0	0	0	0	0

Edge Pixels

**FIG. 8b**

0	0	0	0	0	0	0
0	SE	S	S	SW	0	0
0	E	SE	S	W	W	0
0	E	E	W	W	W	0
0	E	E	W	W	W	0
0	E	E	W	W	W	0
0	E	E	W	W	W	0
0	E	N	E	N	W	W
0	NE	N	N	N	NW	W
0	0	0	0	0	0	0

Direction Values

**FIG. 8c**

BP						
BP						
BP	BP	EP	EP	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	2W	2W	BP	BP	BP
BP	BP	EP	EP	BP	BP	BP
BP						
BP						
BP						

Assignment

BP: Background Pixel

EP: Edge Pixel

2W: Two Pixel Wide Line

**FIG. 8d**

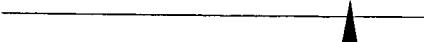
Interior Pixel

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Edge Pixel

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



One Pixel Wide

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Two Pixel Wide

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Toner Consumption

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Character Linewidth

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Shadow

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Asymmetry

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



Exposure Modulation

1 2 3 4 5 7 8 9 10 11 12 13 14 15 16



FIG. 9

FIG. 10

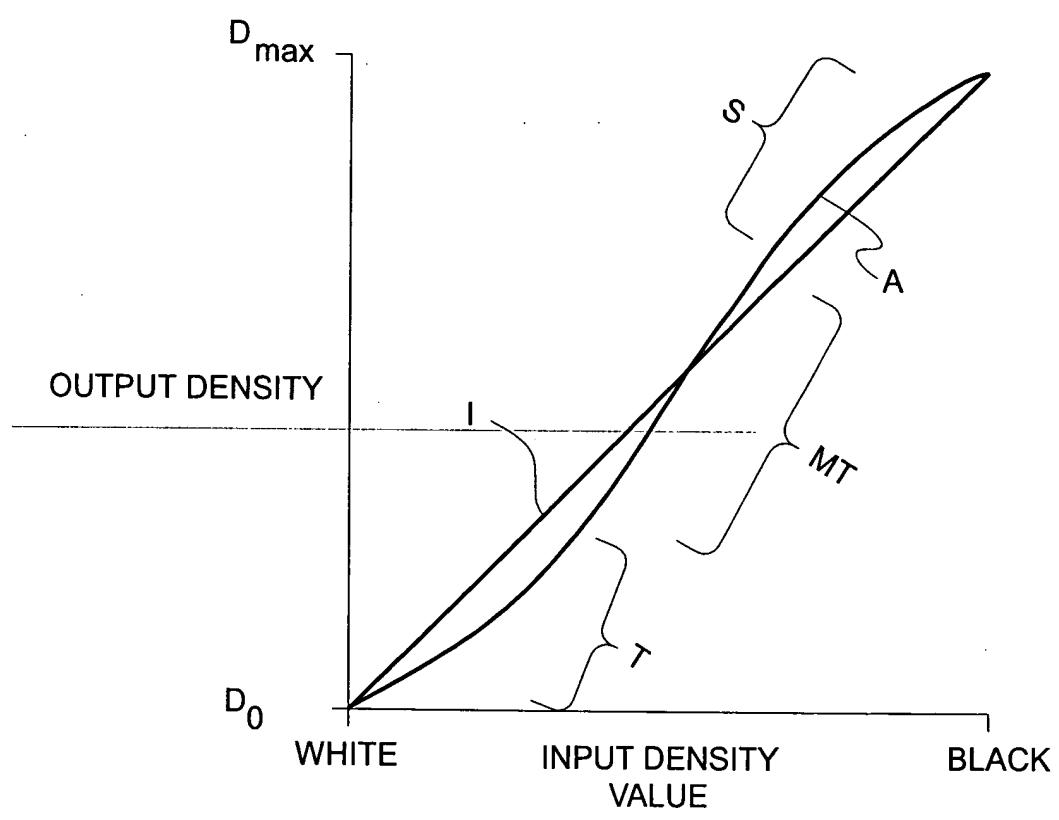


FIG. 11

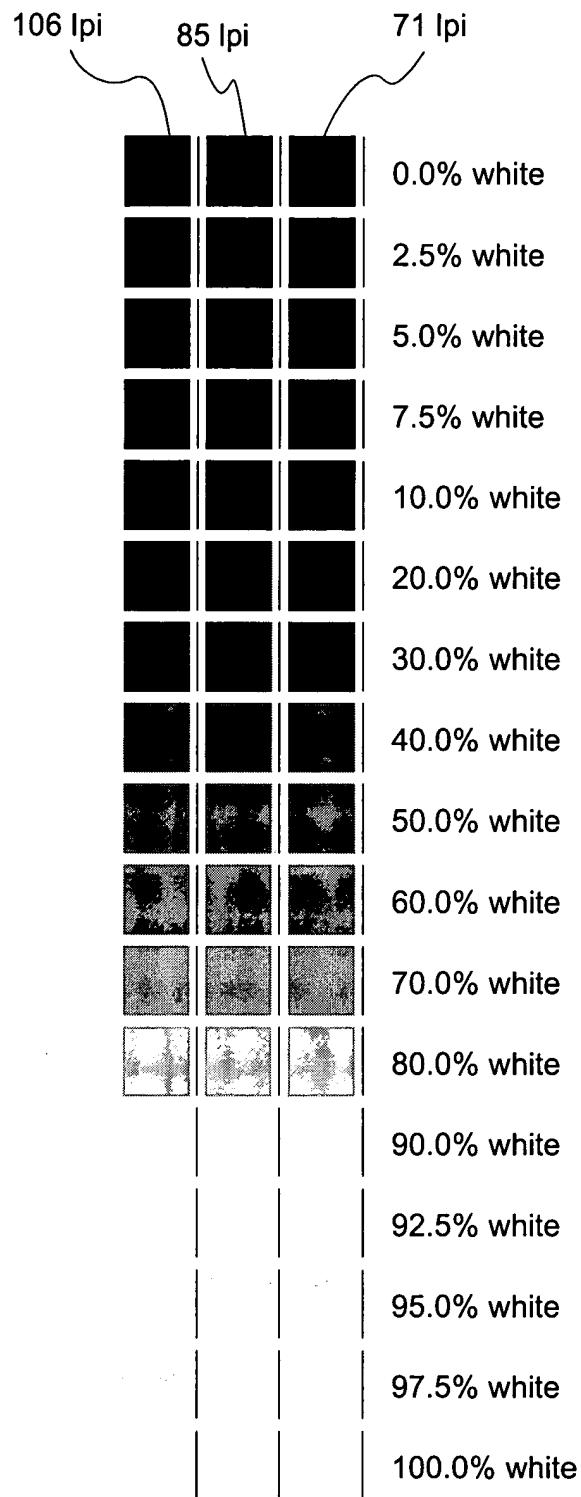
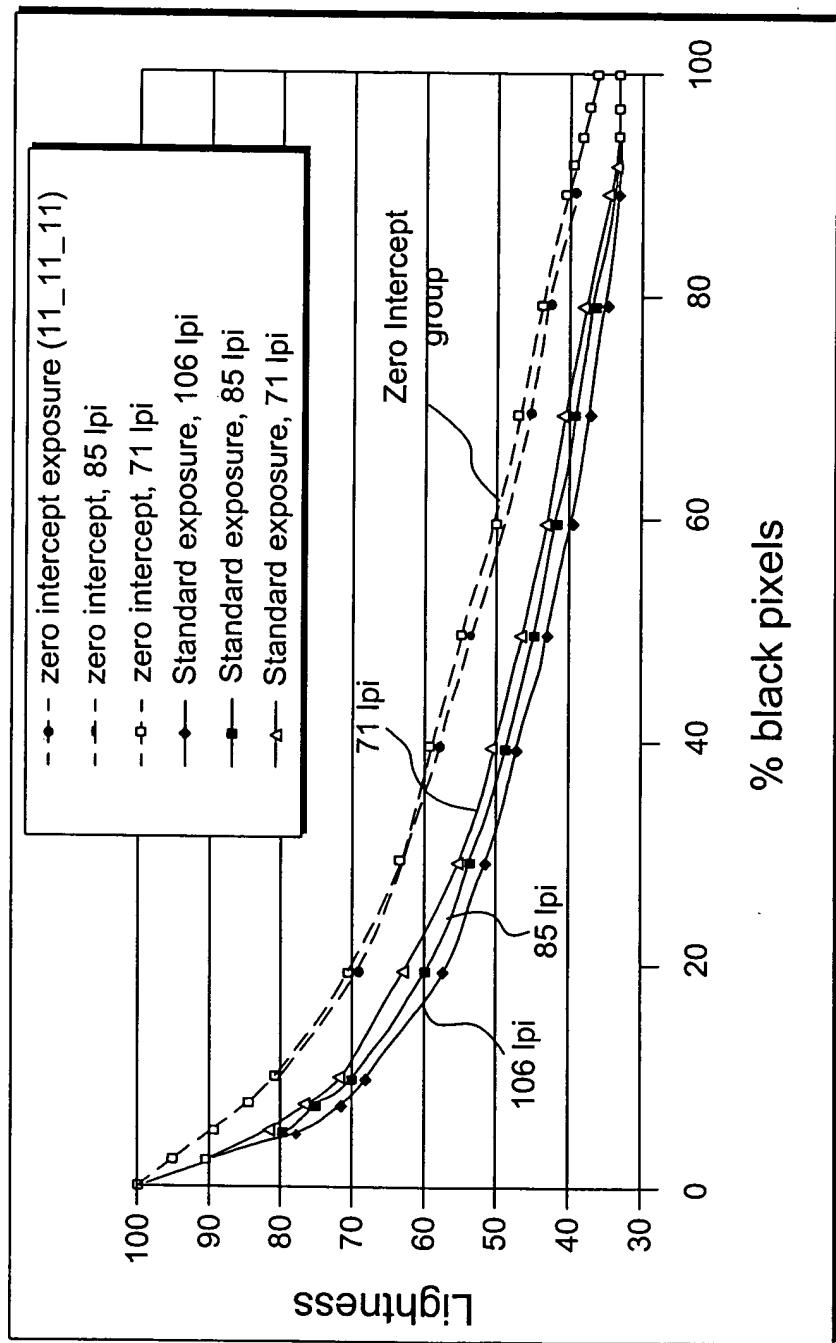


FIG. 12

default round round  
106 85 71

FIG. 13



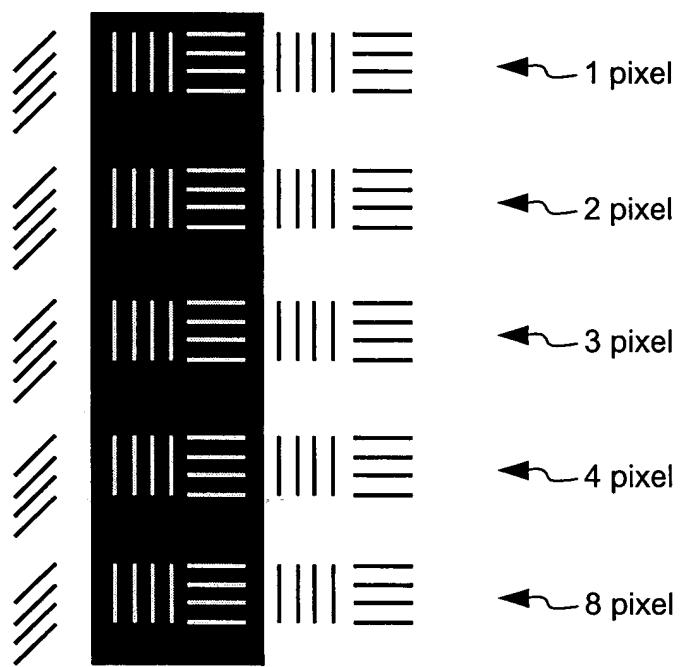


FIG. 14

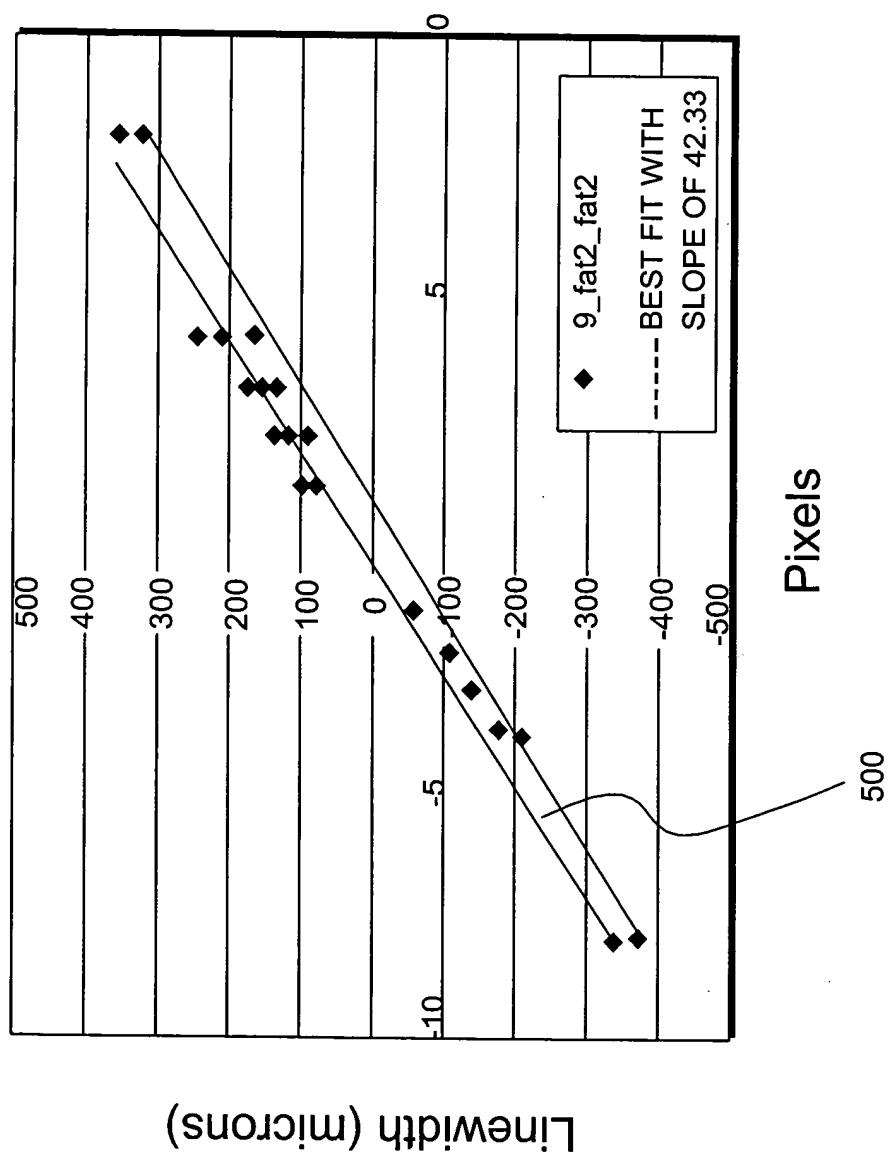
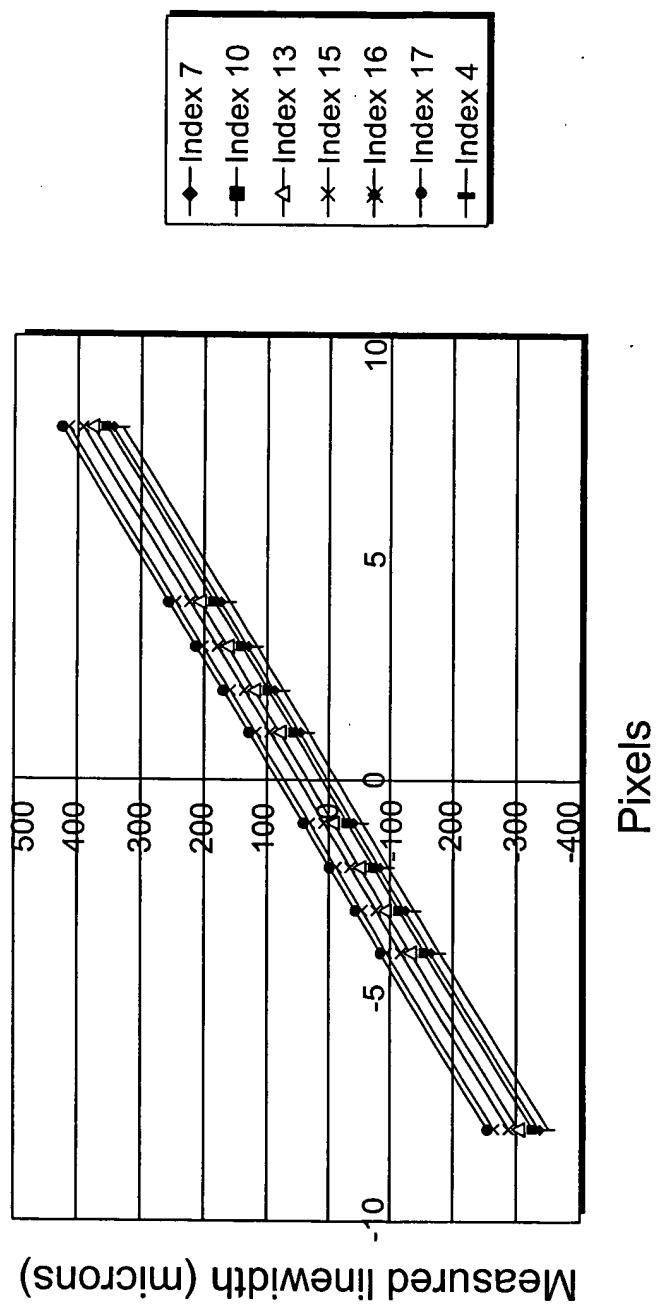


FIG. 15

FIG. 16



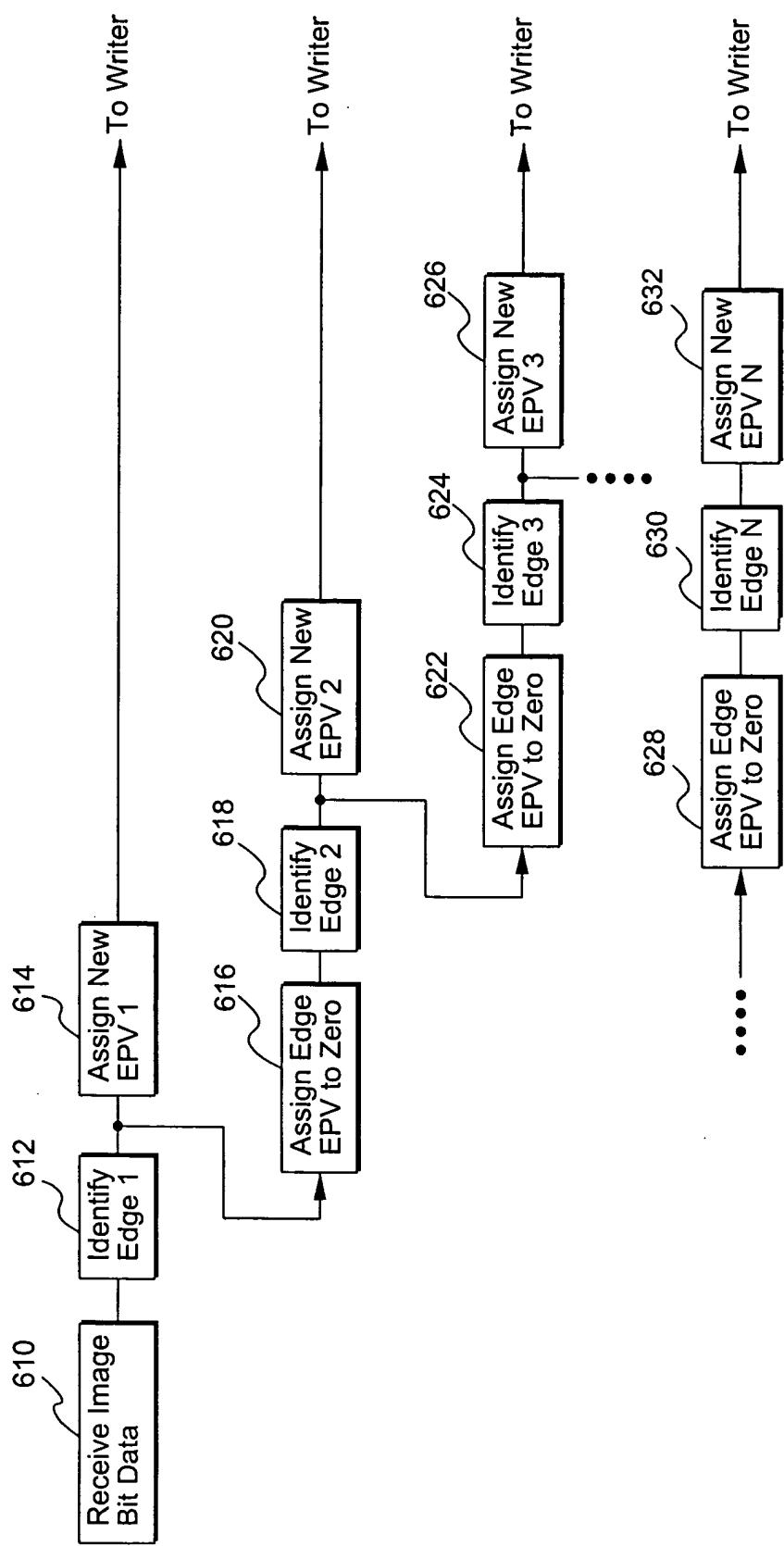


FIG. 17

b7	b6	b5
b4	PIQ	b3
b2	b1	b0

FIG. 18a

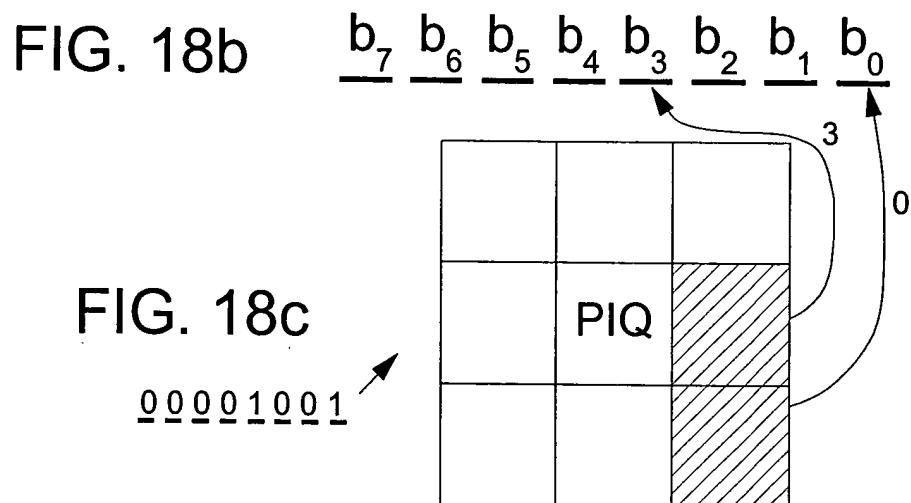
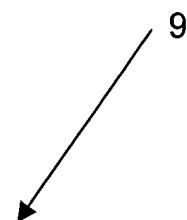


FIG. 18c

00001001

Fig. 18d



0	SE	S	S	SW	S	S	S	E	E	SE	SE	SE	SE	S	SE
W	SW	SW	S	W	SW	SW	SW	0	SE	S	S	SW	S	S	S
NE	E	SE	SE	0	SE	S	S	E	E	E	SE	E	E	SE	SE
NW	0	SW	S	W	SW	SW	S	NE	E	SE	SE	0	SE	S	S
N	NE	0	SE	NW	0	SW	S	NE	E	E	E	NE	E	SE	SE
NW	NW	W	SW	W	W	W	SW	N	NE	0	SE	NW	0	SW	S
N	NE	NE	E	N	NE	0	SE	NE	NE	E	E	NE	E	E	E
N	N	NW	0	NW	NW	W	SW	N	NE	NE	E	N	NE	0	SE
NW	0	SW	S	W	SW	SW	S	NE	E	SE	SE	0	SE	S	S
W	W	W	SW	W	W	SW	SW	NW	0	SW	S	W	SW	SW	S
N	NE	0	SE	NW	0	SW	S	NE	E	E	E	NE	E	SE	SE
NW	NW	W	SW	W	W	W	SW	N	NE	0	SE	NW	0	SW	S
N	N	NW	0	NW	NW	W	SW	N	NE	NE	E	N	NE	0	SE
NW	NW	W	W	NW	W	W	W	N	N	NW	0	NW	NW	W	SW
N	N	N	NE	N	N	NW	0	NE	NE	NE	E	N	NE	NE	E
NW	N	NW	NW	NW	NW	W	W	N	N	N	NE	N	N	NW	0